Finger Clip

[0094] **FIG. 27** illustrates a finger clip embodiment **2700** of a physiological sensor attachment assembly. The finger clip **2700** is configured to removably attach an emitter assembly **500** (**FIG. 6**) and detector assembly **2400** (**FIG. 24**), interconnected by a flex circuit assembly **1900**, to a fingertip. The finger clip **2700** has an emitter shell **3800**, an emitter pad **3000**, a detector pad **2800** and a detector shell **3900**. The emitter shell **3800** and the detector shell **3900** are rotatably connected and urged together by the spring assembly **3500**. The emitter pad **3000** is fixedly retained by the emitter shell. The emitter assembly **500** (**FIG. 6**) is mounted proximate the emitter pad **3000** and adapted to transmit optical radiation having a plurality of wavelengths into fingertip tissue. The detector pad **2800** is fixedly retained by the detector shell **3900**. The detector assembly **3500** is mounted proximate the detector pad **2800** and adapted to receive the optical radiation after attenuation by fingertip tissue.

[0095] **FIG. 28** illustrates a detector pad **2800** advantageously configured to position and comfortably maintain a fingertip relative to a detector assembly for accurate sensor measurements. In particular, the detector pad has fingertip positioning features including a guide **2810**, a contour **2820** and a stop **2830**. The guide **2810** is raised from the pad surface **2803** and narrows as the guide **2810** extends from a first end **2801** to a second end **2802** so as to increasingly conform to a fingertip as a fingertip is inserted along the pad surface **2803** from the first end **2801**. The contour **2820** has an indentation defined along the pad surface **2803** generally shaped to conform to a fingertip positioned over a detector aperture **2840** located within the contour **2820**. The stop **2830** is raised from the pad surface **2803** so as to block the end of a finger from inserting beyond the second end **2802**. FIGS. **29**A-B illustrate detector pad embodiments **3100**, **3400** each having a guide **2810**, a contour **2820** and a stop **2830**, described in further detail with respect to **FIGS. 31 and 34**, respectively.

[0096] FIGS. **30**A-H illustrate an emitter pad **3000** having emitter pad flaps **3010**, an emitter window **3020**, mounting pins **3030**, an emitter assembly cavity **3040**, isolation notches **3050**, a flex circuit notch **3070** and a cable notch **3080**. The emitter pad flaps **3010** overlap with detector pad flaps **3110** (FIGS. **31**A-H) to block ambient light. The emitter window **3020** provides an optical path from the emitter array **700** (**FIG. 8**) to a tissue site. The mounting pins **3030** accommodate apertures in the flex circuit mounting ears **2214** (**FIG. 22**), and the cavity **3040** accommodates the emitter assembly **500** (**FIG. 21**). Isolation notches **3050** mechanically decouple the shell attachment **3060** from the remainder of the emitter pad **3000**. The flex circuit notch **3070** accommodates the flex circuit tail **2206** (**FIG. 22**) routed to the detector pad **3100** (FIGS. **31**A-H). The cable notch **3080** accommodates the sensor cable **4400** (FIGS. **44**A-B). FIGS. **33**A-H illustrate an alternative slim finger emitter pad **3300** embodiment.

[0097] FIGS. **31**A-H illustrate a detector pad **3100** having detector pad flaps **3110**, a shoe box cavity **3120** and isolation notches **3150**. The detector pad flaps **3110** overlap with emitter pad flaps **3010** (FIGS. **30**A-H), interleaving to block ambient light. The shoe box cavity **3120** accommodates a shoe box **3200** (**FIG. 32A**-H) described below. Isolation notches **3150** mechanically decouple the attachment points **3160** from the remainder of the detector pad **3100**. FIGS. **34**A-H illustrate an alternative slim finger detector pad **3400** embodiment.

[0098] FIGS. **32**A-H illustrate a shoe box **3200** that accommodates the detector assembly **2400** (**FIG. 24**). A detector window **3210** provides an optical path from a tissue site to the detector **2410** (**FIG. 24**). A flex circuit notch **3220** accommodates the flex circuit tail **2206** (**FIG. 22**) routed from the emitter pad **3000** (FIGS. **30**A-H). In one embodiment, the shoe box **3200** is colored black or other substantially light absorbing color and the emitter pad **3000** and detector pad **3100** are each colored white or other substantially light reflecting color.

[0099] **FIGS. 35-37** illustrate a spring assembly **3500** having a spring **3600** configured to urge together an emitter shell **3800** (**FIG. 46**) and a detector shell **3900**. The detector shell is rotatably connected to the emitter shell. The spring is disposed between the shells **3800**, **3900** and adapted to create a pivot point along a finger gripped between the shells that is substantially behind the fingertip. This advantageously allows the shell hinge **3810**, **3910** (**FIGS. 38-39**) to expand so as to distribute finger clip force along the inserted finger, comfortably keeping the fingertip in position over the detector without excessive force.

[0100] As shown in FIGS. **36**A-C, the spring **3600** has coils **3610**, an emitter shell leg **3620** and a detector shell leg **3630**. The emitter shell leg **3620** presses against the emitter shell **3800** (FIGS. **38**A-D) proximate a grip **3820** (FIGS. **38**A-D). The detector shell legs **3630** extend along the detector shell **3900** (FIGS. **39**A-D) to a spring plate **3700** (FIGS. **37**A-D) attachment point. The coil **3610** is secured by hinge pins **410** (**FIG. 46**) and is configured to wind as the finger clip is opened, reducing its diameter and stress accordingly.

[0101] As shown in FIGS. **37**A-D the spring plate **3700** has attachment apertures **3710**, spring leg slots **3720**, and a shelf **3730**. The attachment apertures **3710** accept corresponding shell posts **3930** (FIGS. **39**A-D) so as to secure the spring plate **3700** to the detector shell **3900** (**FIG. 39A**-D). Spring legs **3630** (**FIG. 36A**-C) are slidably anchored to the detector shell **3900** (**FIG. 39A**-D) by the shelf **3730**, advantageously allowing the combination of spring **3600**, shells **3800**, **3900** and hinges **3810**, **3910** to adjust to various finger sizes and shapes.

[0102] **FIGS. 38-39** illustrate the emitter and detector shells **3800**, **3900**, respectively, having hinges **3810**, **3910** and grips **3820**, **3920**. Hinge apertures **3812**, **3912** accept hinge pins **410** (**FIG. 46**) so as to create a finger clip. The detector shell hinge aperture **3912** is elongated, allowing the hinge to expand to accommodate a finger.

Monitor And Sensor

[0103] **FIG. 40** illustrates a monitor **100** and a corresponding sensor assembly **200**, as described generally with respect to **FIGS. 1-3**, above. The sensor assembly **200** has a sensor **400** and a sensor cable **4400**. The sensor **400** houses an emitter assembly **500** having emitters responsive to drivers within a sensor controller **4500** so as to transmit optical radiation into a tissue site. The sensor **400** also houses a detector assembly **2400** that provides a sensor signal **2500** responsive to the optical radiation after tissue attenuation.